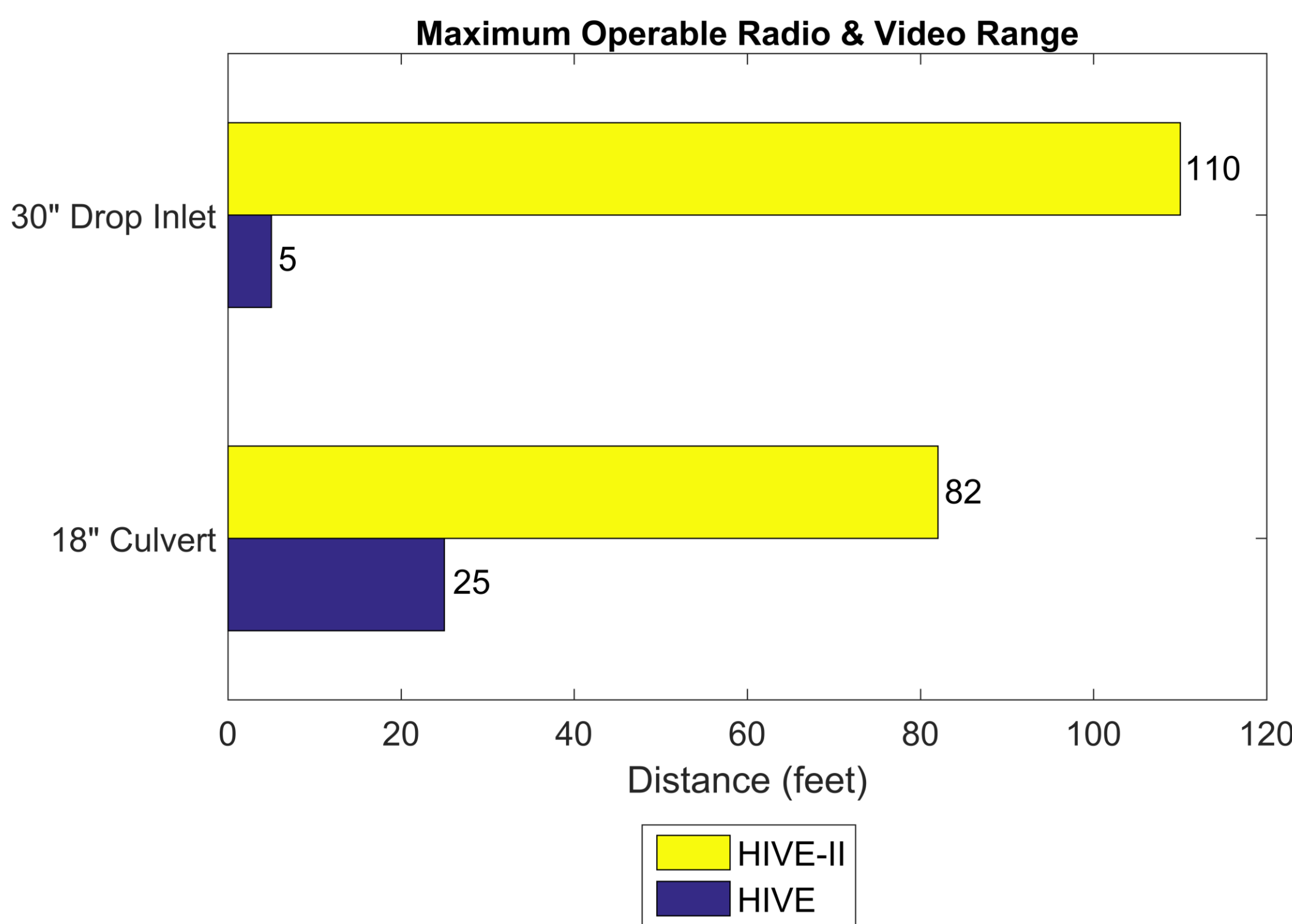


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HIVE-II



Performance of HIVE-II versus original HIVE
(Longer bars are better)

Figure 1. Left: the HIVE-II. Right: comparison of HIVE-II versus original HIVE.

Introduction

The Vermont Agency of Transportation must inspect approximately 9,600 small culverts annually. During inspection, a small remotely controlled vehicle drives through a culvert and streams video of the culvert interior back to the operator. However, of the two inspection vehicles currently available to VTrans, the “Crawler” is too costly for widespread deployment, and the Hydraulic Inspection Vehicle Explorer (“HIVE”) is unable to transmit video from deep within long culverts. In this project, a next-generation culvert inspection vehicle, the “HIVE-II”, is designed to meet VTrans requirements for efficient and effective low-cost culvert inspection.



Figure 2. Photographs from the HIVE-II. Left: a partial blockage has caused sediment buildup in the culvert. Right: the culvert is clear after traversing the partial blockage.

Methodology

A Heng Long 1/16-scale remote control toy tank was chosen for the HIVE-II chassis due to its compact size, low cost, and continuous tracks. Continuous tracks allow it to meet VTrans requirements to span a 6-inch (152 mm) separation gap and remain stationary on a 20-degree slope. Optimal equipment for radio control and video transmission through small culverts is understood through theoretical analysis and a series of field tests. Total materials cost of the HIVE-II is less than \$1,500.

Conclusions

The original HIVE is quite capable but has limitations, Table 1. The HIVE-II offers much greater operating range, improved capability to traverse obstacles and gaps, and precise distance encoding from a tether spool with a digital revolution counter. Figure 1 shows that the HIVE-II equipped with a 5.8 GHz video transmitter provides 100+ feet (30.5+ m) of additional range when operating in a 30-inch (752 mm) drop inlet, and 50+ feet (15.2+ m) of additional range when operating in an 18-inch (457 mm) culvert.

Engineering Specifications	HIVE	HIVE-II
Live footage shall be viewable at least 80 feet into 18-inch culvert	Does not meet specification	Meets specification
Live footage shall be viewable at least 80 feet into culvert with drop inlet	Does not meet specification	Moderately meets spec
Vehicle shall span a gap of at least 6 inches	Does not meet specification	Meets specification
Vehicle shall remain still on a 20-degree slope	Does not meet specification	Meets specification
User shall know vehicle’s distance in culvert to +/- 1 foot at all times	Moderately meets spec	Meets specification

Table 1. VTrans engineering specifications not met by original HIVE design.

Acknowledgments

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